Logistics Management Institute

Another Look at Transfer Prices for Depot-Level Reparables

Marginal Costs: A Revenue Perspective

PA602T1

January 1999

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Contents

FIGURES

TABLES

Chapter 1
Introduction

OVERVIEW

The Joint Chiefs of Staff recently testified before Congress about the disquieting decline in force readiness. Concurrent with the decline in readiness, DoD estimates that the working capital funds had accumulated operating losses totaling $1.7 billion by the end of FY97.[1] The simultaneous decline in readiness and the financial health of the working capital funds is not a coincidence.

Lacking sufficient revenues to pay its expenses, the working capital funds have not bought or repaired many depot-level reparable (DLR) components needed to support weapon systems.

SUMMARY

Full-cost transfer prices for DLR components on weapon systems contribute to the readiness problems now facing DoD. DLR transfer prices are set to recover the working capital funds' total cost of repairing, replacing, transporting, warehousing, and managing DLR components. However, our analysis of those full-cost DLR transfer prices indicates that, instead, they systematically under-collect revenues needed to buy and repair DLRs.

Our research, like other published research literature, advocates the use of marginal-cost transfer prices for DLRs. Using marginal-cost transfer prices would help correct some of the uneconomic behaviors we found. However, a far more compelling reason for such a change would be to lessen the effect on revenue recovery associated with problems in estimating DLR sales, in budgeting customers' DLR funding, and in anticipating customers' reaction to new DLR prices.

ORGANIZATION OF REPORT

Chapter 2 presents the theoretical concerns about using full-cost DLR transfer prices and what we found. In Chapter 3, we summarize the effect that full-cost transfer prices have on working capital fund revenues. Chapter 4 provides the case for changing to marginal-cost DLR transfer prices from the perspective of reducing the perverse effects that full-cost prices have on working capital fund

[1] General Accounting Office, GAO/T-NSIAD/AIMD-97-152, *Defense Depot Maintenance: Challenges Facing DoD in Managing Working Capital Funds,* Washington, D.C.

revenues.[2] For clarity, we put many of the details in two Appendixes: Appendix A provides a more detailed description of the theoretical argument for using marginal-cost transfer prices. Appendix B illustrates how marginal-cost transfer prices will provide more stable revenue than do full-cost transfer prices.

[2] Working capital funds encompass many activities. In this report, we will use the term "working capital fund" only for referring to the supply management activity responsible for managing DLR components.

Chapter 2
Do DLR Transfer Prices Motivate Proper Economic Behavior?

DoD intended DLR transfer prices to motivate economic behavior by signaling to "buyers" the costs of obtaining a serviceable DLR from the working capital fund. By knowing those costs, maintenance managers would be motivated to

- locally repair more DLRs,
- choose less costly alternative sources of repair, and
- adopt less costly support structures.

Full-Cost Transfer Prices Send False Economic Signals

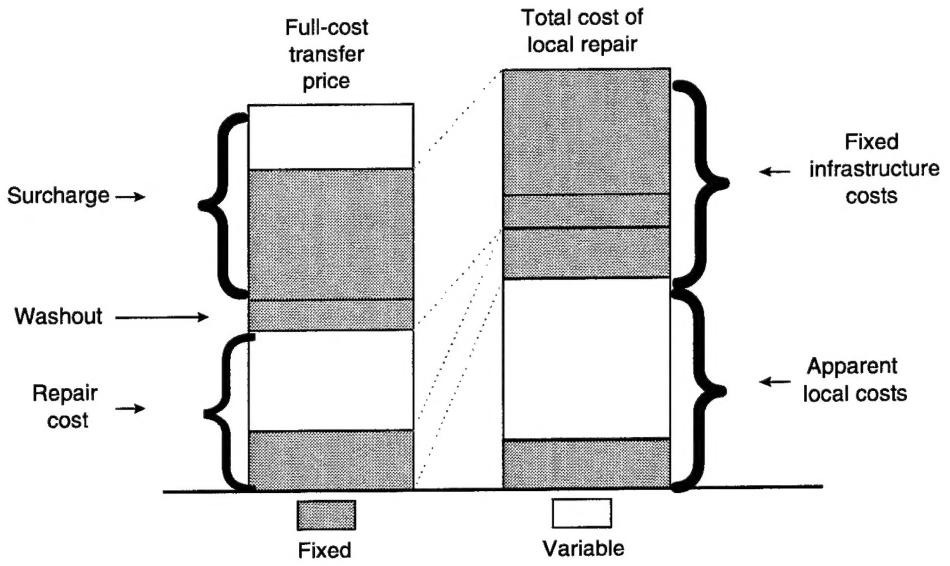
Unfortunately, full-cost DLR transfer prices send false economic signals that *overstate* the actual costs that will be incurred or avoided by obtaining a serviceable DLR from the working capital fund or by locally repairing a DLR (see Figure 2-1 below). As a result, local unit-level maintenance organizations may be repairing as many DLR components as possible to avoid paying the DLR transfer price; however, by doing so, they may actually tie up more DoD resources than if the depot had made the repair. Such uneconomic decisions would be made because many of the costs in the full-cost transfer price (e.g., depot overhead, replacement of washed out DLRs that are beyond economic repair, and many elements in the surcharge for recovering other costs such as a prior year's operating losses or *maintaining sufficient supplies of serviceable DLRs to go to war)* do not disappear if the unit maintenance shop elects to repair the broken DLR component.[1]

As shown in Figure 2-1, when the total cost of the local repair (i.e., local repair costs plus the fixed infrastructure cost of the working capital fund) is greater than the DLR transfer price, local repair will be more costly than if the broken DLR component is exchanged for a serviceable replacement obtained from the working capital fund. By selecting the *more costly* method for obtaining a serviceable

[1] Rogerson develops the idea of nonmarketed outputs, one of which is wartime capacity. These wartime capacity costs are hidden because they are allocated to the cost of peacetime repairs. See: Logistics Management Institute, *On the Use of Transfer Prices Within DoD: The Case of Repair and Maintenance of Depot-Level Reparables by the Air Force,* Report PA303RD1, William P. Rogerson, March 1995.

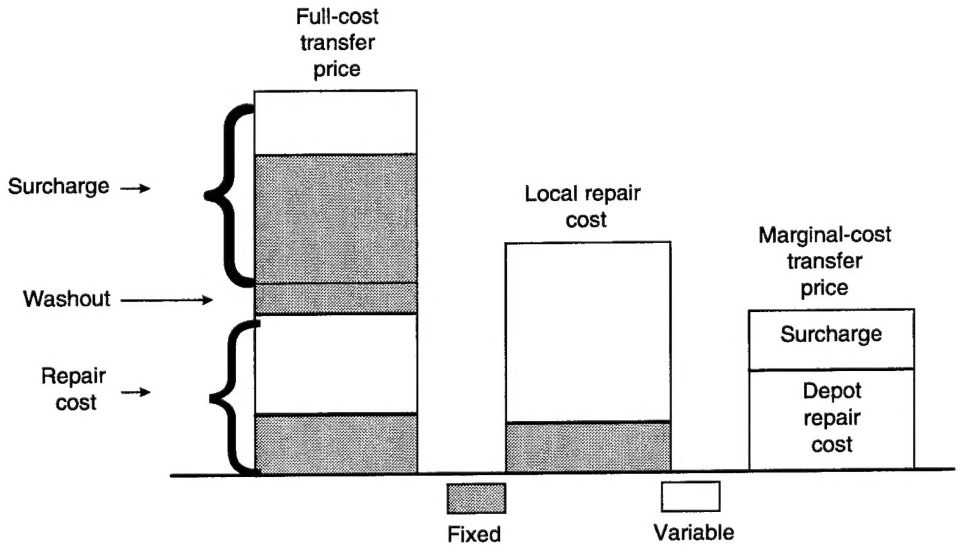
DLR, local repairs unnecessarily absorb total obligation authority (TOA) needed for readiness and sustainability requirements.

Figure 2-1. Full-Cost Transfer Price Versus Total Cost of Local Repair



As illustrated in Figure 2-2, basing transfer prices on the marginal cost of the decision being made (i.e., if the local unit-level maintenance group elects to repair or not repair a DLR component) correctly signals the *real* costs. With a realistic signal of the costs associated with obtaining a serviceable DLR from the working capital fund, unit-level maintenance personnel may be less motivated to repair the DLR.

Figure 2-2. A Comparison of Full-Cost and Marginal-Transfer Prices and Local Repair Cost



When confronted with full-cost DLR transfer prices, unit-level maintenance organizations should be motivated to make more DLR repairs than when DLRs were free-issued and some portion of those repair decisions will be uneconomic. In the next section, we look at how much DLR workload shifted to unit-level after DLR pricing was implemented and how many of those additional repair decisions may have been uneconomic.

MAINTENANCE PERSONNEL ARE PAYING ATTENTION TO DLR PRICES

Unit and depot maintenance managers *are* paying attention to the prices they pay for DLRs and they are actively and creatively searching for the lowest cost repair. Ironically, some of the best supporting evidence results from implementation errors made while trying to improve full-cost transfer prices. The errors caused the transfer price of some DLR subcomponents to become more expensive than the DLR component that is removed directly from a weapon system—commonly referred to as a line replaceable unit (LRU). As a result, unit-level maintenance personnel began returning the LRU instead of the broken subcomponents.[2]

In addition to looking for the lowest cost repair, some other benefits attributed to DLR transfer pricing include the following:

- Military units are more careful about returning DLRs to the working capital fund. We were told that in the Army, many DLR items thought lost, miraculously reappeared after DLR transfer prices were implemented. Clearly, motivating units to return DLRs will reduce unnecessary expenditures for replacing lost DLRs.[3] We did not investigate those effects in our study because, charging any price (marginal cost or just a flat fee) most likely would have motivated similar behavior; having a better inventory tracking system may have prevented the problem in the first place.

- Data provided by Air Force units we interviewed indicated that charging a transfer price for DLRs produced another benefit. Because base resources are tied up while a DLR is undergoing local repair (what they refer to as the repair float), base personnel are paying closer attention to the number of DLRs in the base repair cycle. As a result of this local emphasis (and

[2] Usually, returning an LRU instead of the broken subcomponent has a more detrimental effect on weapon systems readiness because the LRU is removed directly from the weapon system. Usually, to maximize weapon system readiness, one repairs the LRU by replacing the broken subcomponent and returning the broken subcomponent for repair.

[3] After being issued a serviceable DLR by the working capital fund, if customers do not return a similar DLR (either serviceable or unserviceable) they pay a higher DLR transfer price. Thus avoiding this additional cost motivates local maintenance shops to return a DLR component to the working capital fund for every one they are issued.

emphasis from higher headquarters), after only 2 years of DLR transfer pricing, the base repair cycle for DLRs at this base dropped from 8.3 to 4 days.[4]

IMPACT OF USING FULL-COST DLR TRANSFER PRICES IS LIMITED

Despite the occasional horror story, little evidence supports the contention that the use of full-cost DLR transfer prices is causing a widespread shift of repair from the depot level to the local level or is tying up substantial amounts of TOA from making uneconomic repair decisions.[5] Two factors may explain this finding:

- Unit-level maintenance personnel indicated that DLR prices had little impact on how many repairs were made—stating that all possible repairs permitted by technical orders already were being made to meet weapon system readiness requirements before DLR transfer pricing went into effect.[6]

- Although the working capital fund established a quasi buyer-seller relationship whereby DLR prices could in theory affect repair decisions, that buyer-seller relationship was superimposed over a command-directed economy where technical orders, not price, determine what can and cannot be repaired.

As a result, regardless of the transfer prices used, before significant changes in unit-level DLR repairs will occur, the technical orders must be changed or waivers must be approved. This technicality may have protected DoD from grievous harm, for in those relatively few areas where units could expand local repair, they did so dramatically.

[4] Information provided to the Logistics Management Institute (LMI) during interviews conducted on October 17, 1994, with Seymour-Johnson Air Force Base personnel. The source of the repair-cycle data is the ACC203 program that Air Combat Command uses for monitoring repair-cycle effectiveness of military units under its authority.

[5] We planned to study the repair histories of Army and Air Force DLRs before and after DLR pricing was implemented (because data for those Services was more readily available than was Navy data). However, after seeing the Air Force results, our sponsor concurred with our recommendation to drop the before and after analysis of the Army data and instead limit our analysis of Army data to those DLRs where expanded unit-level repair had been approved.

[6] The major exceptions happened when trained personnel were unavailable or required test equipment, tools, parts, etc., were unavailable or unserviceable.

SOME TROUBLING BEHAVIORS MOTIVATED BY FULL-COST TRANSFER PRICES

While the magnitude of problems associated with using full-cost transfer prices is far less than expected, there are still problems. Some of the more troubling include the following:

- We reviewed 2,272 DLR items that experienced at least a 25 percent increase in the unit's propensity to repair DLR components after full-cost DLR transfer prices were implemented. By making those additional repairs, unit maintenance managers would think they saved their budgets $243 million each year by avoiding the DLR transfer prices. However, based on our estimates of the marginal costs of repairing those items, 81 percent of those savings are illusionary. The grossly inflated savings, signaled by full-cost DLR prices, can only encourage unit-level maintenance managers to further expand unit-level maintenance capability at the same time depot-level repair facilities have excess capacities.

- Unit-level maintenance organizations are requesting more waivers to technical orders in order to expand unit-level repair capability. Each Service has established formal programs (e.g., Gold Flag in the Air Force) to encourage that end.[7]

  - Units are actively attempting to find alternative sources of depot-level repair for DLR components. We were informed by one Gold Flag manager that they had been authorized to send a DLR directly to the same commercial repair source as used by the item manager and that under the contractual arrangements they paid the same repair cost as the item manager. This was certainly a good deal for the base, they got the item repaired quicker and they spent less money. However, the net effect of such a scheme is that the item manager did not receive revenue from the nonrepair-related portion of the DLR price to pay for the nonrepair-related costs of supporting the DLR.

  - We reviewed 119 requests for expanded unit-level repair and found that one out of three requests would have been disapproved if marginal-cost transfer prices had been the decision criterion. Had the economic decision been made, that Service could have saved at least $1.7 million—a small percentage of that Service's total DLR budget.

- Maintenance organizations (both at the unit-level and depot-level) are repairing DLRs for which there are excessive numbers of serviceable items

[7] These programs also encourage expanded repair of consumable items. Often simple repairs can fix a consumable (i.e., throw-away) part so that a new one is not needed.

sitting in a warehouse so that they can receive credit when the DLR item is returned to the working capital fund.[8]

- Full-cost recovery methodologies sometimes produce DLR transfer prices having little relationship to the cost (full or marginal) of the item. For example, in 23 percent of the 119 requests for expanded repair, the full-cost transfer price did not recover enough revenue to pay the depot repair bills for those DLRs.[9] In other cases, the transfer price is many times greater than the repair cost (see Table 2-1 for several examples). In the Air Force, the transfer price for some DLRs is more than 4,000 percent higher than the actual depot repair cost. For example, consider this part (national stock number 5865012587063EW) used on the B-1B. The material recovery rate (intended to recover the cost of buying new DLRs) included in the transfer price for this item is $371,750 per item; however, the depot-level repair cost included in the transfer price is only $9,179. These types of pricing anomalies frustrate efforts to make visible and to reduce the ownership costs of either individual DLRs or entire weapon systems and certainly motivate creative ideas to avoid using grossly overpriced DLRs.

Table 2-1. Comparisons of Transfer Prices and Depot Repair Cost

Item	Transfer price	Depot repair cost
Power supply	$3,243	$1,500
Circuit card	$3,167	$1,098
Circuit card	$3,188	$80

- Decisions on alternative support concepts (e.g., two-level maintenance and direct vendor delivery) or privatizing government support functions are complicated by using full-cost transfer prices. Using full-cost transfer prices for such decisions requires an in-depth analysis of the real marginal costs. In the case of decisions affecting depot repair workloads valued at least $3 million per year, using full-cost transfer prices requires an evaluation of how the fixed depot overhead costs contained in the DLR prices

[8] One item for which expanded unit-level repair had been approved had 1,500 serviceable items in the warehouse—approximately a 6.5-year supply.

[9] We derived the transfer price by applying the Army's credit policy to the Federal logistics (FEDLOG) price and then comparing those prices with the average total depot-level repair costs (including the general and administrative and production overhead costs) reported in the Army's depot cost-accounting system.

will be redistributed among the other DLR workloads—a difficult and contentious task.[10]

SUMMARY

Although technical orders constrain the shift of many depot-level repairs to the unit level, maintenance organizations still have some ability to minimize the effect that full-cost DLR prices have on their budget. Many of the more creative ideas at best only shift the burden of the nonrepair portion of DLR prices onto someone else, and at worst, they have a devastating effect on the revenues the working capital fund needs to buy and repair DLR components for weapon systems.

In the next chapter, we consider how full-cost DLR transfer prices affect the working capital funds' ability to collect enough revenues to buy and repair DLR components.

[10] GAO/NSIAD-97-13, *Air Force Depot Maintenance: Privatization-in-Place Plans Are Costly While Excess Capacity Exists*, Washington, D.C., 1996. When outsourcing depot workloads of at least $3 million, GAO stipulates (and DoD has agreed) that the rate effects that fixed depot overhead costs have on remaining workload must be considered. Those effects were a significant factor in awarding the C-5 depot workload to Warner Robins Air Logistics Center.

Chapter 3
Concerns About Revenues from DLRs

Revenues obtained from selling DLR services to customers are the primary source of funding that working capital funds use to buy and repair DLR components for weapon systems. Each Service has implemented different procedures for determining what is a sale and when revenue from those sales is recognized; however, for our purposes we will define a sale as occurring every time a DLR is issued and the same or a similar but unserviceable DLR is returned in its place.[1] With this definition the working capital fund receives revenue for each sale it makes to a customer. Thus, total revenue from those sales during budget execution is calculated as shown in equation 3-1.

$$WCF\ revenue = \sum_{i=1}^{all\ customers} \sum_{j=1}^{all\ DLRs} Full-cost\ transfer\ price(j, T_0 - 2) \times Actual\ sales\ (i, j, T_0), \qquad \text{[Eq. 3-1]}$$

where T_0 = budget execution year.

Because working capital funds are supposed to break-even each year (or at least over), full-cost DLR transfer prices are set deliberately to recover the total costs of operating the working capital fund including those requirements for buying and repairing DLRs. However, as shown in equation 3-2, in order for customers to budget for DLR funding, DLR prices must be estimated from forecasts of the working capital fund's operating expenses (including the costs associated with buying and repairing DLR components and from forecasts of DLR sales).

$$Full\text{-}cost\ transfer\ price(j, T_0 - 2) = \frac{Forecast\ WCF\ operating\ cost\ at\ T_0 - 2}{\sum_{i=1}^{all\ customers} Forecast\ sales\ at\ T_0(i, j, T_0 - 2)}. \qquad \text{[Eq. 3-2]}$$

If the prices are set incorrectly because the working capital funds' operating expenses were not known accurately and/or, if the amount of customer sales does not

[1] As noted earlier, the working capital fund also receives revenue if customers do not return a DLR for every DLR they are issued. Also, some DLRs are issued without the expectation of a DLR being returned (e.g., some foreign military sales customers buy DLRs that will be maintained by repair sources in their country). For clarity purposes, we omit these details and focus only on revenues produced when DLR components are issued with the expectation that a similar one will be returned to the working capital fund. The problems we highlight in our report are applicable to these other sources of revenue.

materialize as assumed in the budget, then the working capital fund may not receive enough revenue to buy or repair all the DLR components needed.

SALES FORECASTS HAVE INCREASED IMPORTANCE

DLR transfer pricing has increased the importance of forecasting customer sales accurately (i.e., the number of unserviceable DLRs that will be returned to the stock fund).[2] Before DLRs were placed in working capital funds, errors in forecasting sales only affected the budgets for buying and repairing DLRs. Once approved, the funds appropriated by Congress were available to the Services for buying and repairing DLRs. Since full-cost DLR transfer prices were implemented, those same sales forecast errors now affect how much will be budgeted for *all* requirements associated with managing and supporting DLRs, as well as, how much of the approved funding in customers budget will be translated into revenue for the working capital fund.

Although the importance of sales forecasts has increased, forecasting sales has proven difficult for DoD to accomplish in the past and efforts that customers take to avoid DLR transfer prices only exacerbate the problem.

OVERESTIMATING SALES RESULTS IN LOW DLR PRICES

Historically, forecasts of DLR sales overestimate the actual DLR sales. For one Service, DLR sales forecasts are overestimating actual sales by an average of 20 percent. From equation 3-2, we can observe that other things being equal, overstated sales forecasts will result in DLR prices that are too low. Unrealistic DLR transfer prices affect the customer's funding requested in budgets by underestimating how DLR prices may change in the future. They also affect the revenue that the working capital funds actually will receive. Even if customers have budgeted the correct funding, unrealistically low transfer prices may not collect enough revenue during budget execution to buy and repair all needed DLR components. Potentially, a 20 percent error in forecasting DLR sales could result in DLR prices that under-collect $600 million of revenue annually from just one of three working capital funds.

[2] To the extent that the working capital funds' future expenses can be forecast will be when customers must develop budgets and when DLR prices must be set, the better are the chances that the working capital funds will have enough revenue to buy and repair DLR components. Estimates of buy and repair requirements for DLRs often experience large variations, sometimes as much as 30 percent in 3 months. This problem is not new. Placing the management and support of DLRs into a working capital fund has not made the problem worse.

UNIT-LEVEL AND DEPOT-LEVEL EFFORTS TO AVOID PAYING DLR TRANSFER PRICES

Compounding the revenue problems caused by forecasting errors are the actions that both unit-level and depot-level maintenance organizations take to avoid paying DLR transfer prices.

Maintenance Changes How Many DLRs Are Repaired

One action being taken is to increase unit-level repair of DLRs. While a unit's capability to increase local repair is limited by "technical orders," any such increase in local repair, *whether economic or not*, has a disproportionately large impact on the working capital funds' revenue, especially during budget execution. We referred previously to our analysis of 2,272 DLRs and the false economic signals being sent to local repair managers. While those signals may be false to the local level, they are real to the working capital fund: *They signal a real loss of revenue.* We estimate that for every $1 the working capital fund could reduce its operating cost by response to increased local repair during budget execution, the fund loses $6 of revenue.[3] This imbalance between cost reduction and revenue reduction occurs because many of the wholesale-level costs associated with supporting DLRs are unrelated to whether the unit or depot repairs a DLR. Because the revenue for such nonrepair-related requirements is collected through full-cost DLR transfer prices, if the DLR is repaired locally, the working capital fund will not receive revenue to pay those nonrepair-related bills.

Depot-level maintenance can avoid paying the nonrepair-related portions of the DLR transfer price by electing to repair broken DLRs (removed during the overhaul of ships, tanks, aircraft, or engines) instead of buying a replacement from the working capital fund. Again, because the revenue for such nonrepair-related requirements is collected through full-cost DLR transfer prices, the working capital funds will not receive revenue to pay those nonrepair-related bills.

Maintenance Changes How DLRs Are Repaired

Further reducing working capital fund revenues are changes in how unit-level maintenance group's repair DLRs. Here are two examples:

- As mentioned earlier, unit-level maintenance activities, in some cases, are returning broken LRUs (instead of the broken subcomponents within the LRU) because the transfer price for returning the entire LRU is less than the price for the subcomponent. Similarly, they can also "shop" within

[3] This is based on our estimate of the marginal costs that could be avoided during budget execution, which we assume is limited to the direct costs incurred during depot repair during budget execution.

interchangeable and substitutable groups to find the least costly DLR. The likely effect of these changes is less revenue for the working capital fund.

- Another action effecting revenue is called cross-cannibalization—"cross-canning" for short. Unit-level maintenance personnel have cross-canned DLR components during periods of parts shortages to maximize weapon system readiness. This practice involves concentrating as many broken subcomponents as possible into one LRU before it is returned to the depot for repair. With cross-canning, instead of receiving revenue every time a broken subcomponent is returned, the working capital fund now receives revenue only when the LRU is returned. In the extreme case of two-level maintenance (e.g., F-16 avionics),[4] cross-canning will result in the working capital funds receiving exactly the same number of broken DLRs to repair but receiving only 25 percent or less of the revenue.

Having elaborated on the effect that full-cost transfer prices are having, we turn next to the case for changing to marginal-cost transfer prices for DLRs.

[4] With two-level maintenance, LRU black boxes are removed from a weapon system, bench-checked to verify a failure, and returned to the depot if the failure is verified.

Chapter 4
Marginal-Cost Transfer Prices Would Help With the Revenue Problem

In response to the growing financial crisis facing the working capital fund, OSD and the Services are rethinking the working capital fund concept. One of many changes being considered is the use of DLR transfer prices based on marginal costs. Previous LMI research by Rogerson (1995),[1] and a recent RAND report authored by Baldwin and Gotz (1998),[2] advocate marginal-cost transfer prices for DLRs as a means of motivating economic behavior. (A summary of the theoretical arguments for marginal-cost transfer pricing is provided in Appendix A.) Our research also supports the marginal cost concept for DLR pricing; however, a far more pragmatic reason for making such a change is to reduce the effect that full-cost transfer prices have on total revenue.

MARGINAL-COST TRANSFER PRICES LESSEN THE IMPACT OF SALES FORECAST ERRORS

Changing to marginal-cost transfer prices *will not* affect the Services' ability to forecast either sales or its requirements; however, marginal-cost transfer prices will lessen the impact those forecasting errors will have on revenue collection. With the quantities of DLRs involved, using marginal-cost transfer prices for DLRs will not recover all costs of the working capital fund.[3] Some other funding mechanism will be needed to recover costs associated with the "fixed" and/or the nonrepair-related activities needed to support and manage DLRs.[4]

Transfer prices that recover only the marginal cost of DLRs, coupled with some other mechanism for recovering the fixed costs of supporting DLRs, will disconnect the revenue recovery of nonrepair-related DLR requirements from the generation of DLR sales (i.e., reparable returns). Because those revenues would not

[1] Logistics Management Institute, *On the Use of Transfer Prices Within DoD: The Case of Repair and Maintenance of Depot-Level Reparables by the Air Force,* Report PA303RD1, William P. Rogerson, March 1995.

[2] The RAND Corporation, *Transfer Pricing for Air Force Depot-Level Reparables,* Laura H. Baldwin and Glenn A. Gotz, 1998.

[3] Technically, this occurs because, at the quantities of DLR services demanded by customers, the long-run average total cost curve of the working capital fund is above its long-run marginal cost curve.

[4] Rogerson notes that when nonrepair-related costs are recovered through a fee associated with the repair of the DLR, those nonrepair-related costs behave just like a fixed cost with respect to the number of repairs.

be tied to sales (or at least directly tied to the sale of repair services), the persistent errors in forecasting sales will have significantly less effect on total working capital fund revenues (see Appendix B for an illustration of how this happens).

At the same time marginal-cost transfer prices lessen the effect on revenues, they

- provide customers with the information needed to make economic decisions about repairing a DLR locally or sending it to a depot, and
- make the revenue effects resulting from economic local repair decisions more congruent with the actual resource changes the working capital fund will experience, especially during budget execution.

A Concern About Using Marginal Costs

One objection to using marginal costs would be that direct billing of the fixed costs might impair visibility of the total cost of weapon systems or divert management attention away from controlling those costs. If properly done, such direct billing actually could increase management attention by providing more visibility of fixed costs that are of most interest to customers (e.g., the requirement for buying spare parts needed for wartime).

DoD intends the working capital funds to obtain its revenue from transfer price(s) charged to customers.[5] That does not mean the working capital fund has to recover the costs of all the services it provides from the transfer price charged for just one service repair. Presumably direct billing could be done in such a manner that the amount of the bill is related to how much of a specific service is consumed by each customer. Rogerson suggests several services that may be separately billed:

- Replacing washed-out DLRs that are beyond economic repair
- Procuring and maintaining items needed for wartime
- Providing access to a worldwide inventory of serviceable DLRs that can be used while broken DLR components are being repaired.

Changing to marginal-cost transfer prices for DLR will offer many advantages to DoD. The next chapter summarizes our conclusions.

[5] Under Secretary of Defense (Comptroller), *Defense Business Operations Fund: DBOF Foundation for Mission Success,* prepared by CALIBRE Systems Inc., Falls Church VA (undated).

Chapter 5
Conclusions

Simply changing from full-cost to marginal-cost DLR transfer prices will neither solve all the revenue problems of the working capital fund nor will it resolve the readiness problems. However, by providing a more stable source of predictable revenue, marginal-cost transfer prices will enable DoD to better address its readiness problems while at the same time it attempts to address and rectify many other problems that currently prevent the perceived benefits of working capital funds from being realized.

A decision to change to marginal-cost DLR transfer pricing also will create other challenges that must be addressed, such as these:

- To what extent must one implement marginal-cost transfer prices to motivate economic behavior? Baldwin and Gotz of the RAND Corporation envision a very detailed set of transfer prices. However, another LMI study of 6 of the top 10 U.S. commercial air carriers suggests a very simple set of transfer prices may be sufficient.[1] While that issue is being studied and argued, a good starting place may be to use the average depot repair costs already available.

- How should the fixed and nonrepair-related costs associated with DLRs be recovered?

- Must DoD rely on transfer prices used in its financial accounting systems to provide sufficient visibility of the total ownership costs of weapon systems?

[1] Logistics Management Institute, *A Comparison of Air Force and Commercial Wholesale Inventory Accounting,* Report AF804T1, David Glass et al., October 1998.

Appendix A
Theoretical Arguments for Marginal Cost Transfer Prices

One purpose for implementing transfer prices is to motivate efficient use of the DLR components produced by the working capital funds. In the case of DLRs, transfer prices are intended to provide economic signals to the maintenance organization as to whether it should make the repair or return the broken DLR to the working capital fund for repair. For such decisions, economic theory suggests that transfer prices should be set to recover the marginal cost of providing the service (i.e., the extra costs that the working capital fund will incur if it repairs the DLR versus if it does not).[1,2]

FULL-COST TRANSFER PRICES DISCOURAGE THE USE OF INTERNALLY PROVIDED SERVICES

In previous LMI research, Rogerson identified some problems with full-cost DLR transfer prices. Although his comments are specific to transfer prices developed by the Air Force, they are applicable to all DLR transfer prices within DoD. Full-cost transfer prices include the following:

- The fixed costs of operations that do not vary with changes in the amount of service provided.
- The costs of nonmarketed outputs. Rogerson argues that although the working capital funds only market the repair service, it also provides other "nonmarketed" products such as (1) access to an inventory of spares while a malfunctioning component is being repaired or (2) buying new DLR components to replace those beyond economic repair. The costs of providing those unmarketed services will occur regardless of whether the unit elects to repair a DLR or elects to have the working capital fund make a repair.[3]

[1] Logistics Management Institute, *On the Use of Transfer Prices Within DoD: The Case of Repair and Maintenance of Depot-Level Reparables by the Air Force,* Report PA303RD1, William P. Rogerson, March 1995.

[2] The RAND Corporation, *Transfer Pricing for Air Force Depot-Level Reparables,* Laura H. Baldwin and Glenn A. Gotz, 1998.

[3] Rogerson also argues that the additional cost of wartime capacity is also an unmarketed output of the working capital fund. The cost of which is also allocated to peacetime repairs.

Because the working capital funds must operate on a break-even basis, it must increase the cost of the services it does market (i.e., the repair) to recover its fixed costs and the cost of nonmarketed outputs. Thus, full-cost DLR transfer prices

> ...[create] a set of incentives for military units that is clearly incorrect. Regardless of where the repair occurs, a military unit always relies on the supply system for access to an inventory of spares to replace the malfunctioning component while it is repaired. Thus, the military unit is told that if it decides to perform a repair on base, it can have access to the supply system for free...[thus]...military units will quite rationally choose to do repairs on-base even when repairs could be more cheaply accomplished at the depot. [Rogerson p. 4-1].

Collectively, the effect of including costs not associated with the location of a repair decision overstates the marginal cost of those decisions. As a result of inflated cost information provided by full-cost transfer prices, on-base maintenance organizations will be overly motivated to repair as many DLR components as possible and, thus, shift as many repairs as possible away from the depot.

FULL-COST TRANSFER PRICES MAY RESULT IN HIGHER TOTAL COSTS

To the extent that the local marginal cost of repair is higher than the marginal cost of returning a DLR to the depot for repair, such a shift in workload will result in uneconomic decisions that result in higher total cost for DoD. The following three figures illustrate that point.

Figure A-1 shows the components of the DLR transfer price (the repair cost, the washout cost for replacing items beyond economic repair, and a surcharge for recovering all other costs) and the apparent local repair costs that on-base maintenance organizations would see. The fixed and variable portions of each are identified. In this hypothetical example, the local repair costs are lower than the full-cost transfer price so the local maintenance shop would be motivated to make this repair.

Figure A-2, compares the transfer price with the total cost after the local repair is made. Here we see that because the fixed infrastructure costs of the working capital fund do not go away if the repair is made locally, the local repair actually results in higher costs to the Service or DoD. In the long run after new prices are computed, those fixed infrastructure costs or the working capital fund will be redistributed to some other DLRs and will result in someone else paying higher prices. However, until prices can be recomputed, the working capital fund must still pay those fixed costs—it just will not receive any revenue to make those payments.

Figure A-1. Full-Cost Transfer Price Versus Local Repair Cost

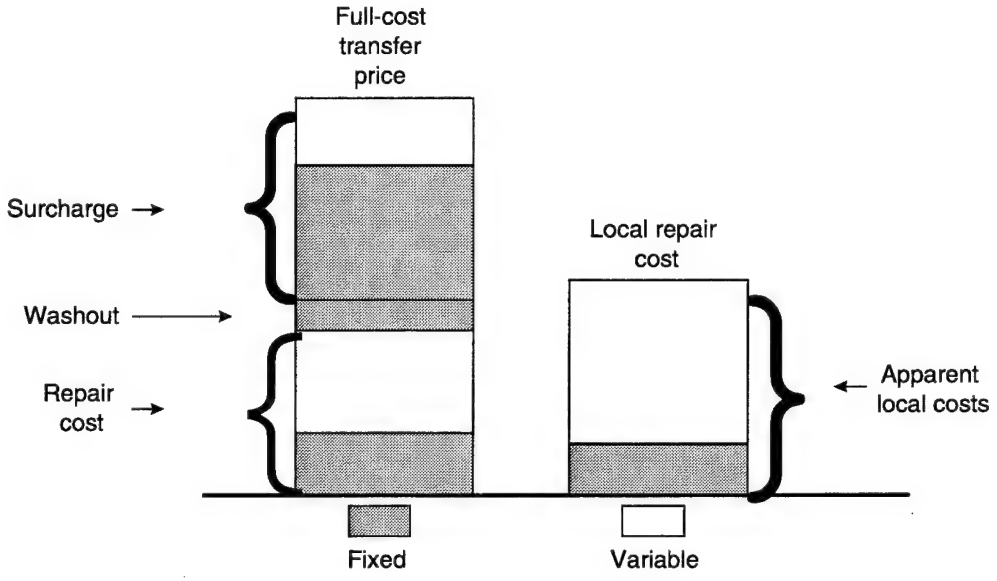
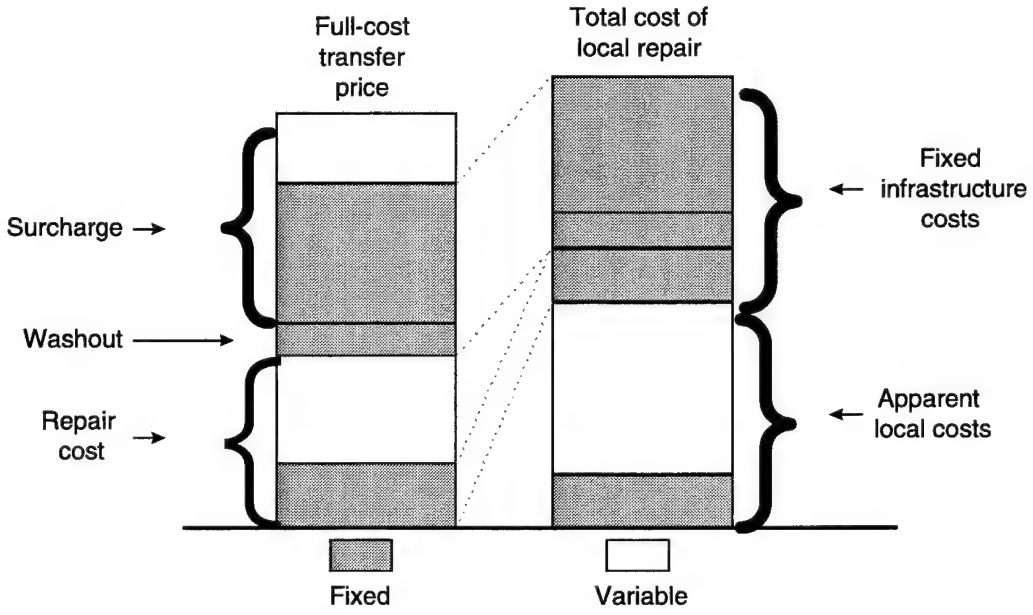


Figure A-2. Full-Cost Transfer Price Versus Total Cost of Local Repair

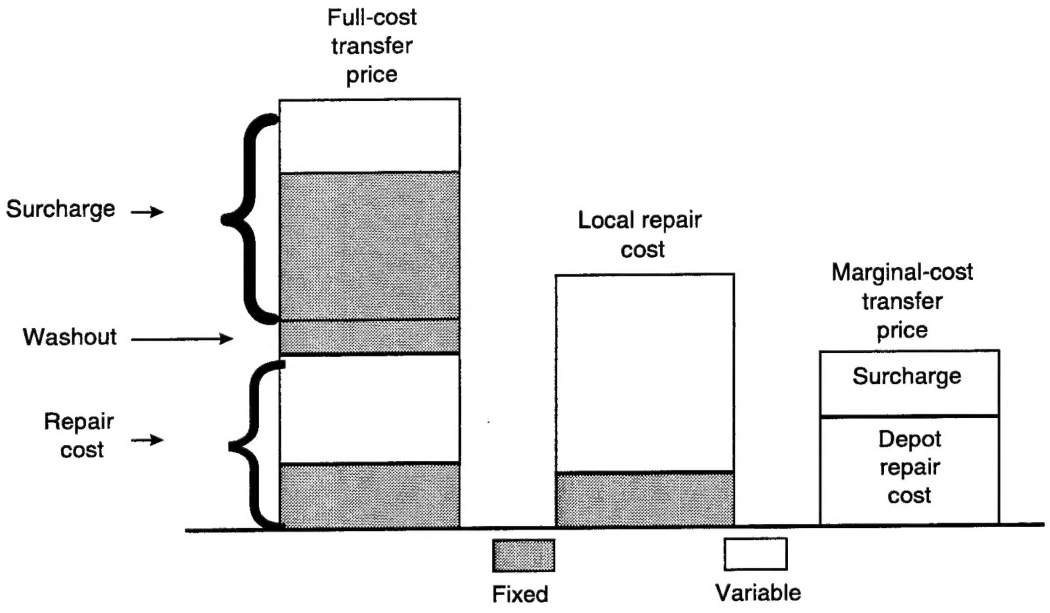


MARGINAL-COST TRANSFER PRICES MOTIVATE LEAST-COST DECISIONS

Figure A-3 shown below, has the same information as Figure A-1, but we have added an additional column to indicate the marginal-cost transfer price. Now we can see that when the variable cost of local repair is compared to the marginal-cost transfer price, local repair actually costs more. Thus, with marginal-cost

transfer prices, local decisions are also the least-cost decisions. More importantly, with marginal-cost transfer prices, the revenue for paying the fixed costs of the working capital fund do not depend on the location of the repair decision. The working capital fund still incurs those cost; however, with marginal-cost transfer prices it also receives revenues for those requirements.

Figure A-3. A Comparison of Full-Cost and Marginal-Cost Transfer Prices and Local Repair Cost

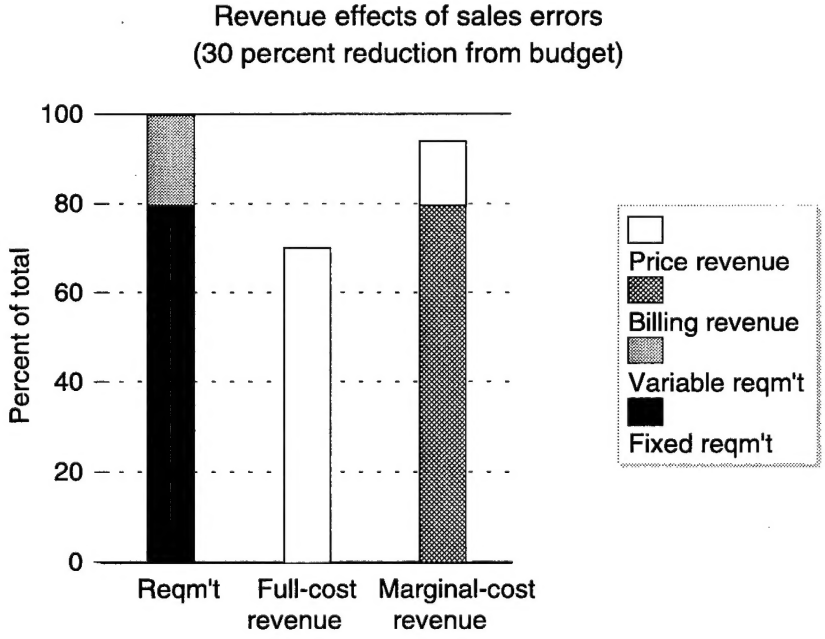


Appendix B
An Illustration of How Marginal-Cost Transfer Prices Lessen the Effect of Sales Forecast Errors

Why would transfer prices based on marginal cost mitigate the revenue problem? Because it subjects a much smaller percentage of the working capital funds' revenues to the vicissitudes of actual sales.

Realistically, marginal-cost DLR transfer prices will not recover all costs of the working capital fund. Some other funding mechanism (e.g., direct billing) will be needed to recover those costs associated with the "fixed" and/or the nonrepair-related activities needed to support and manage DLRs. Figure B-1 illustrates the effect that errors in forecasting sales have on revenues when revenues are collected with full-cost DLR transfer prices and when revenues are collected through a combination of marginal-cost DLR transfer prices and direct billings. For illustration, we assume that 80 percent of the working capital fund costs are fixed with respect to the amount of DLR sales (consistent with our analysis of 2,272 DLRs).

Figure B-1. A Hypothetical Example



The first bar on the chart shows the total working capital funds' requirement for revenue segmented into those requirements that vary with sales (i.e., the repair

workload) and those that are fixed. If the sales generates exactly as forecasted, then the revenue collected from full-cost transfer prices will exactly equal the requirement and the working capital funds' will break even. However, if only 70 percent of expected sales are realized, then the second and third bars illustrate how much revenue will generate.

Bar 2 shows how much revenue will be recovered if all revenue is collected through full-cost DLR transfer prices. Because all revenue is collected from full-cost transfer prices applied to actual sales of DLRs (i.e., the return of broken DLRs for repair), when actual sales are only 70 percent of the anticipated sales, only 70 percent of the expected revenue is collected.

Bar 3 shows the revenue collected with a combination of marginal-cost DLR transfer prices and direct billings for the fixed cost and nonrepair-related costs of the working capital fund. In this situation, the direct billing revenue is independent of actual DLR sales. Thus, the revenue impact is limited to just those collected through the marginal-cost transfer price—when actual sales are only 70 percent of those anticipated, 95 percent of the expected revenue is collected. Clearly managing a 5 percent revenue shortfall will be less painful than having to cope with a 30 percent revenue shortfall during budget execution.

Since marginal-cost-based transfer prices would provide only enough revenue to pay the variable costs of the working fund, the fixed costs would have to be funded from some other source (e.g., direct appropriations or direct billing). Because those revenues to pay the fixed costs would not be tied to sales (or at least directly tied to the sale of repair services), the persistent errors in forecasting sales would have significantly less effect on total revenues and on readiness.

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Full-cost transfer prices for DLR components on weapon systems contribute to the readiness problems now facing DoD. DLR transfer prices are set to recover the working capital funds' total cost of repairing, replacing, transporting, warehousing, and managing DLR components. However, our analysis of those full-cost DLR transfer prices indicates that instead they systematically under-collect revenues needed to buy and repair DLRs.

Our research, like other published research literature, advocates the use of marginal-cost transfer prices for DLRs. Using marginal-cost transfer prices would help correct some of the uneconomic behaviors we found. However, a far more compelling reason for such a change would be to lessen the effect on revenue recovery associated with problems in estimating DLR sales, in budgeting customers DLR funding, and in anticipating customers' reaction to new DLR prices.

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